
Distribution of Causes in Selected North American Aviation Accident Reports Between 1996 and 2003

(slightly simplified)

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Outline

- Motivation
- Method
- What We Found
- Meaning

(The first person to identify the motivation for this style of outline will receive a prize of nominal value.)

Motivation

You Have Heard it Said ...

- “Many accident investigations do not go far enough. They identify the technical cause of the accident, and then connect it to a variant of ‘operator error’ — the line worker who forgot to insert the bolt, the engineer who miscalculated the stress, or the manager who made the wrong decision.” — CAIB report, p. 97
- “Accident investigations stop as soon as they find someone to blame.” — world famous M.I.T. professor
- “What do you mean, things have changed?!! The NTSB still doesn’t get it! Never has! Never will!” — vocal critic at ISSC 2003 panel discussion
- “Human error causes 80% of all accidents.” — thousands

Are These Criticisms Valid?

- Critics seldom cite evidence, and when they do the evidence is old and of dubious value
- Intuition based on reading oodles of accident reports was that the criticisms are (at best) broad generalizations
- Decided to conduct a simple study to collect current evidence

Two Main Questions

- Do investigators usually blame operators?
- Do investigators stop as soon as they find someone to blame?

Method

Initial Decisions - 1

- Concentrate on fairly recent aviation accident reports
 - Aviation selected as the domain because of relative maturity of investigations
 - 1996 selected as start date because reports available on the web
- Consider only what the reports explicitly identify as causal factors
- Conduct independent analysis and then compare results

Initial Decisions - 2

- Enforce independence by
 - Not using a predetermined taxonomy
 - Not communicating until individual analysis completed
- Begin with NTSB reports from major aviation investigations (AAR's not AAB's)
 - 26 reports
 - Oldest — AAR-96-01: In-Flight Icing Encounter and Loss of Control
Simmons Airlines, d.b.a. American Eagle Flight 4184 Avions de Transport Regional (ATR) Model 72-212, N401AM Roselawn, Indiana October 31, 1994
 - Most recent — AAR-03-03: Loss of Control and Impact With Terrain
Aviation Charter, Inc. Raytheon (Beechcraft) King Air A100, N41BE Eveleth, Minnesota October 25, 2002

Example — causal statement

The National Transportation Safety Board determines that the probable cause of the Korean Air flight 801 accident was the captain's failure to adequately brief and execute the non-precision approach and the first officer's and flight engineer's failure to effectively monitor and cross-check the captain's execution of the approach. Contributing to these failures were the captain's fatigue and Korean Air's inadequate flight crew training. Contributing to the accident was the Federal Aviation Administration's (FAA) intentional inhibition of the minimum safe altitude warning system (MSAW) at Guam and the agency's failure to adequately manage the system.

Extract Probable Causes

The National Transportation Safety Board determines that the probable cause of the Korean Air flight 801 accident was **the captain's failure to adequately brief and execute the non-precision approach and the first officer's and flight engineer's failure to effectively monitor and cross-check the captain's execution of the approach.** Contributing to these failures were the captain's fatigue and Korean Air's inadequate flight crew training. Contributing to the accident was the Federal Aviation Administration's (FAA) intentional inhibition of the minimum safe altitude warning system (MSAW) at Guam and the agency's failure to adequately manage the system.

Extract Contributory Factors

The National Transportation Safety Board determines that the probable cause of the Korean Air flight 801 accident was the captain's failure to adequately brief and execute the non-precision approach and the first officer's and flight engineer's failure to effectively monitor and cross-check the captain's execution of the approach. Contributing to these failures were the captain's fatigue and Korean Air's inadequate flight crew training. Contributing to the accident was the Federal Aviation Administration's (FAA) intentional inhibition of the minimum safe altitude warning system (MSAW) at Guam and the agency's failure to adequately manage the system.

Potential Differences

The National Transportation Safety Board determines that the probable cause of the Korean Air flight 801 accident was the captain's failure to adequately brief and execute the non-precision approach and **the first**

officer's and flight engineer's failure to effectively monitor and cross-check the captain's execution of the approach

Contributing to these failures were the captain's fatigue and Korean Air's inadequate flight crew training. Contributing to the accident was the Federal Aviation Administration's (FAA) intentional inhibition of the minimum safe altitude warning system (MSAW) at Guam and the agency's failure to adequately manage the system.

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How many instances of human error?

1, 2, 4?

Later Decisions

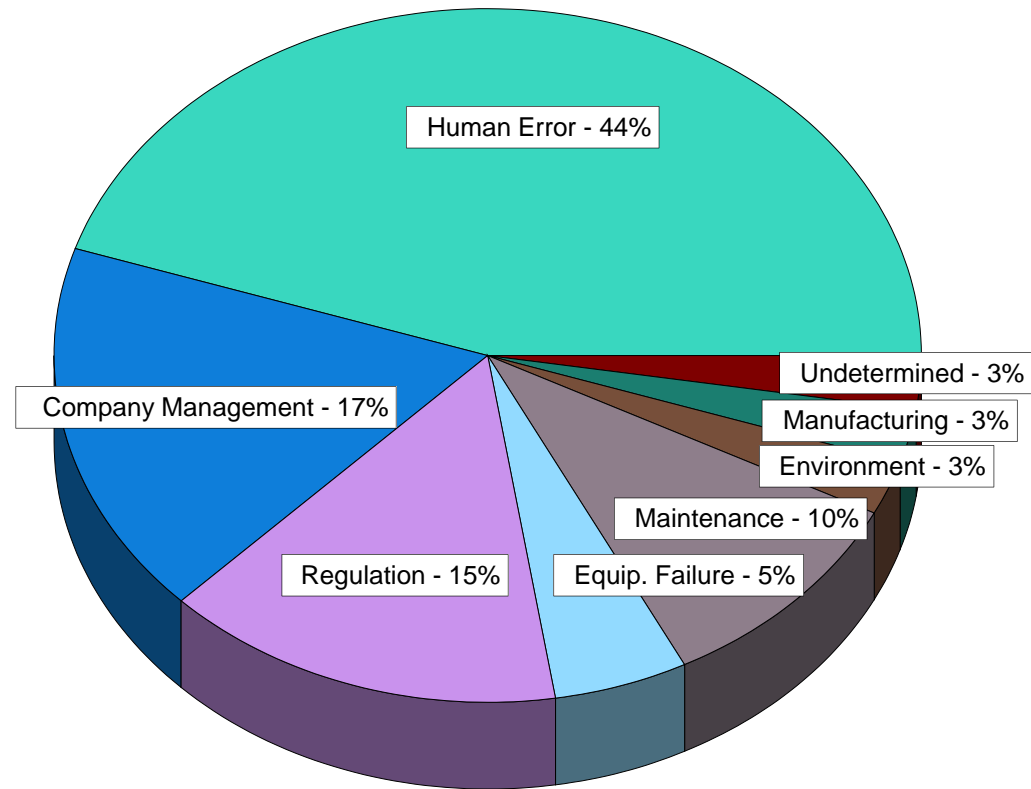
- Conduct similar study on accident reports from the Canadian Transportation Safety Board (TSB)
 - Not directly comparable because of differences in report styles and nature of accidents
 - TSB does not have the AAR/AAB distinction, so we chose the reports having separate numbered sections as being closest equivalent to AAR's
 - 27 total reports

What We Found — NTSB

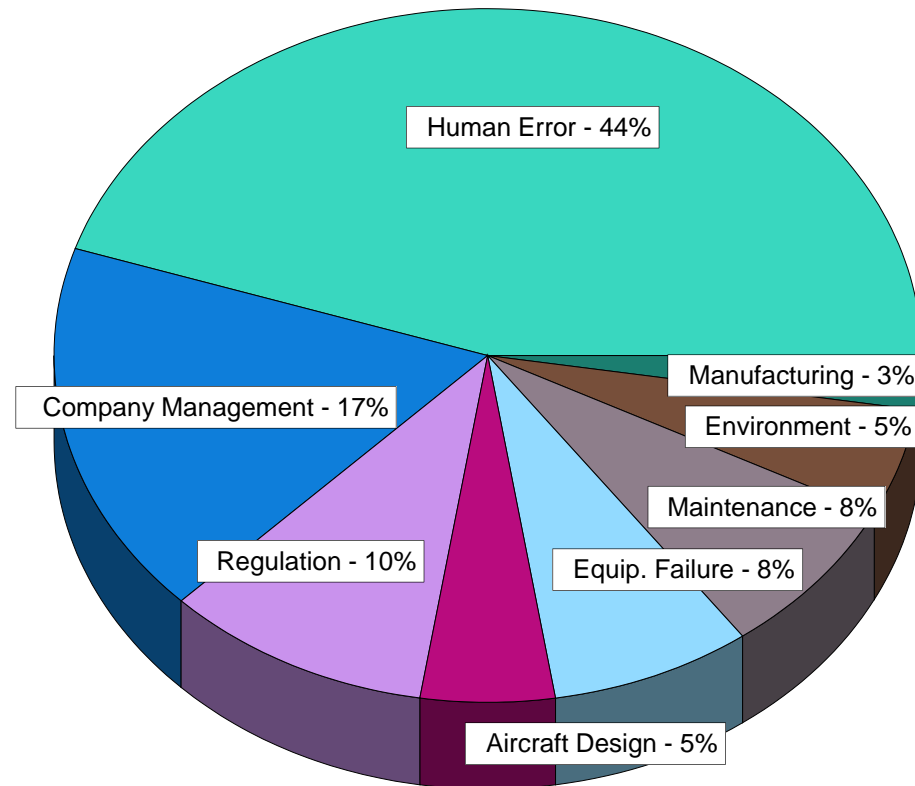
Probable Cause Distribution (NTSB)

	Chris	Michael
HumanError	18 (13)	18 (13)
Maintenance	4 (4)	3 (3)
Company	7 (5)	7 (5)
Regulation	6 (3)	4 (2)
Equipment	2 (2)	3 (3)
Aircraft	0	2 (2)
Manufacturing	1 (1)	1 (1)
Environment	1 (1)	2 (2)
Undetermined	1 (1)	0
Total	40 (26)	40 (26)

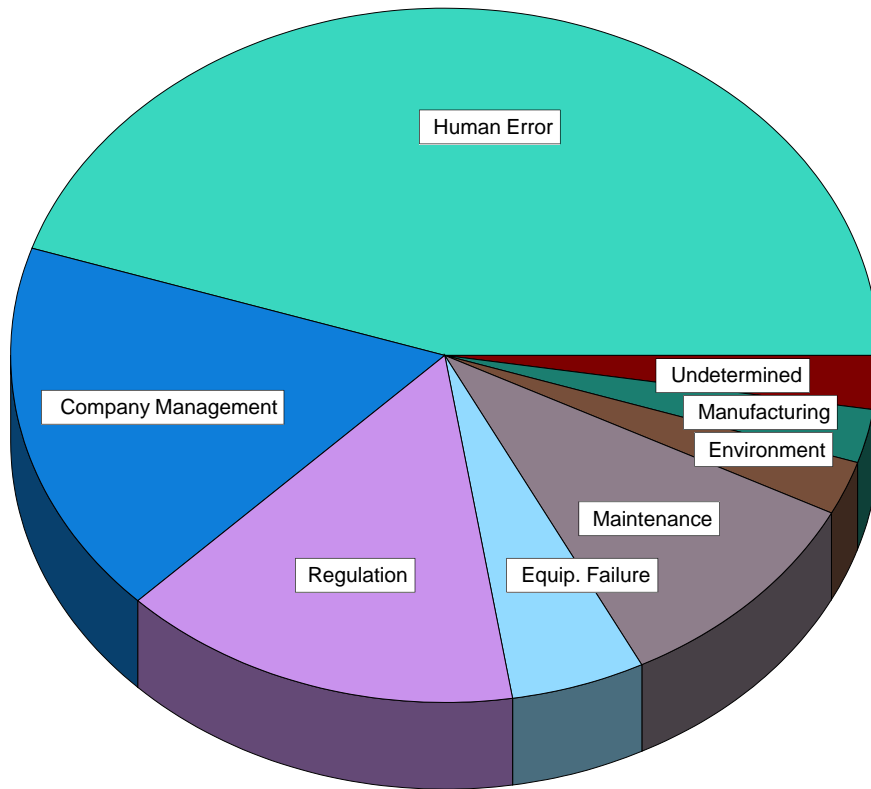
NTSB Probable Causes (Chris)



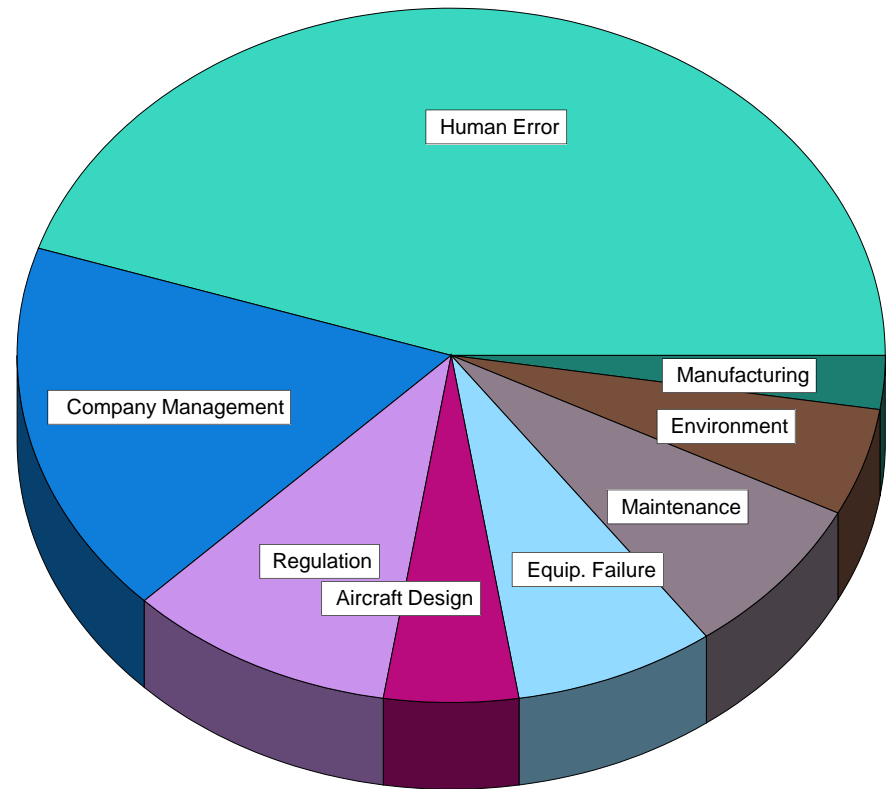
NTSB Probable Causes (Michael)



NTSB Probable Causes (both)

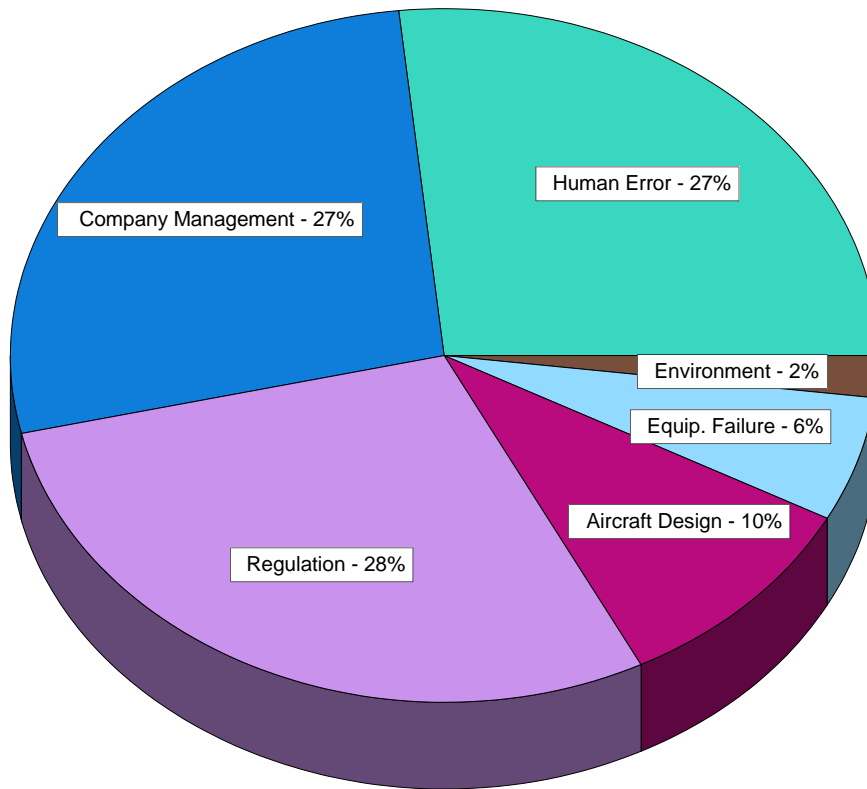


Chris

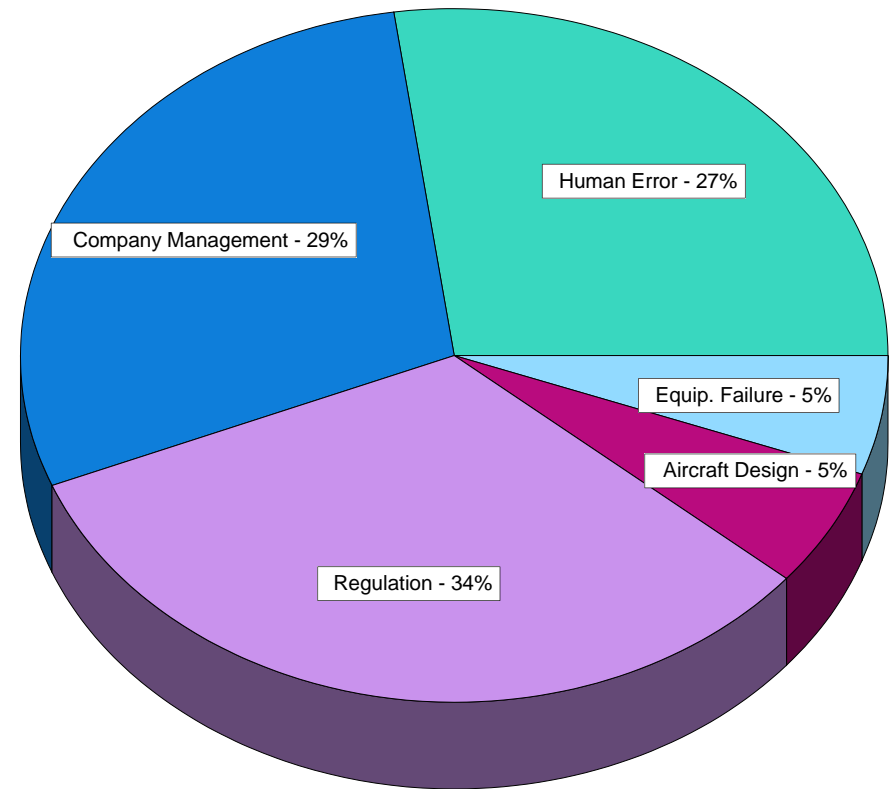


Michael

NTSB Contributory Causes (both)



Chris

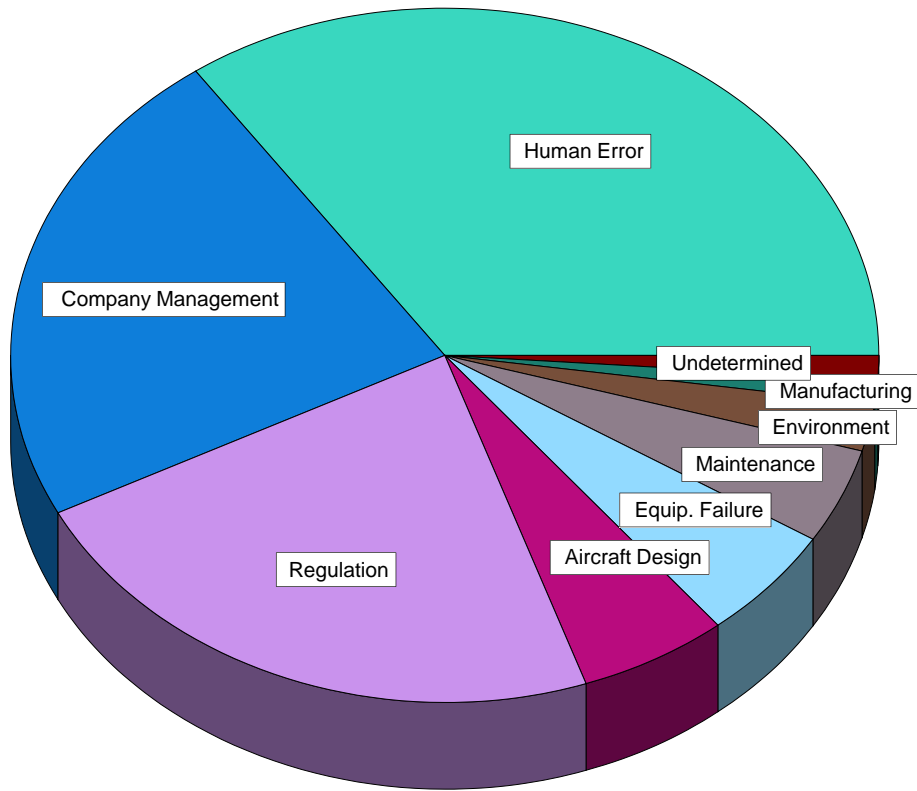


Michael

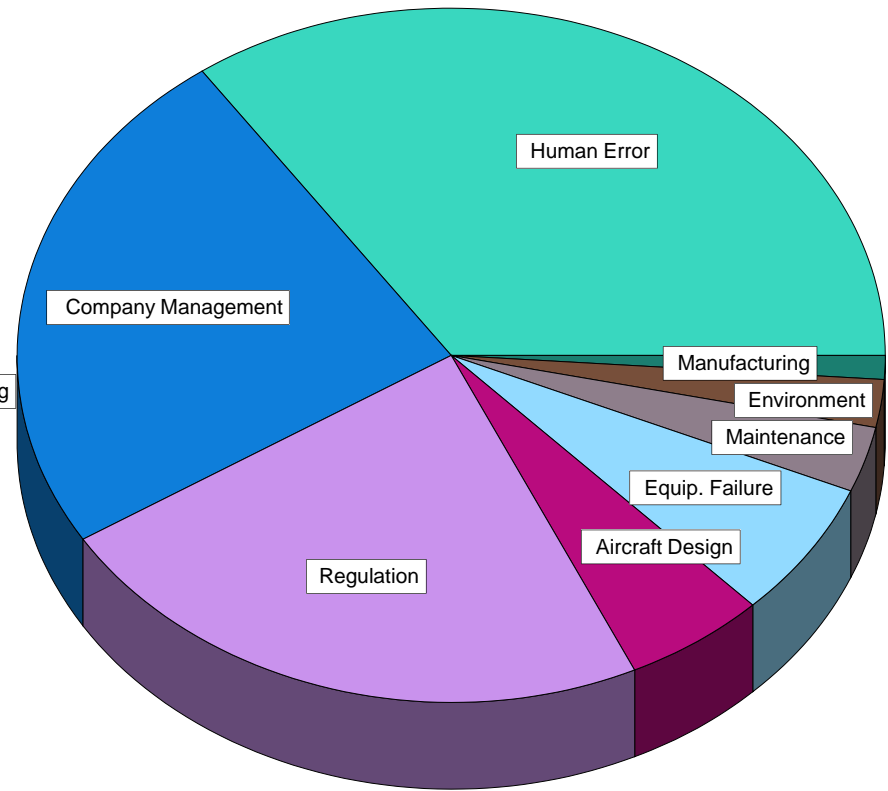
Combined Cause Distribution (NTSB)

	Chris	Michael
Human	35%	36%
Maintenance	4%	3%
Company	24%	24%
Regulation	23%	23%
Equipment	5%	6%
Aircraft	5%	5%
Manufacturing	1%	1%
Environment	2%	2%
Undetermined	1%	0

NTSB Combined (both)

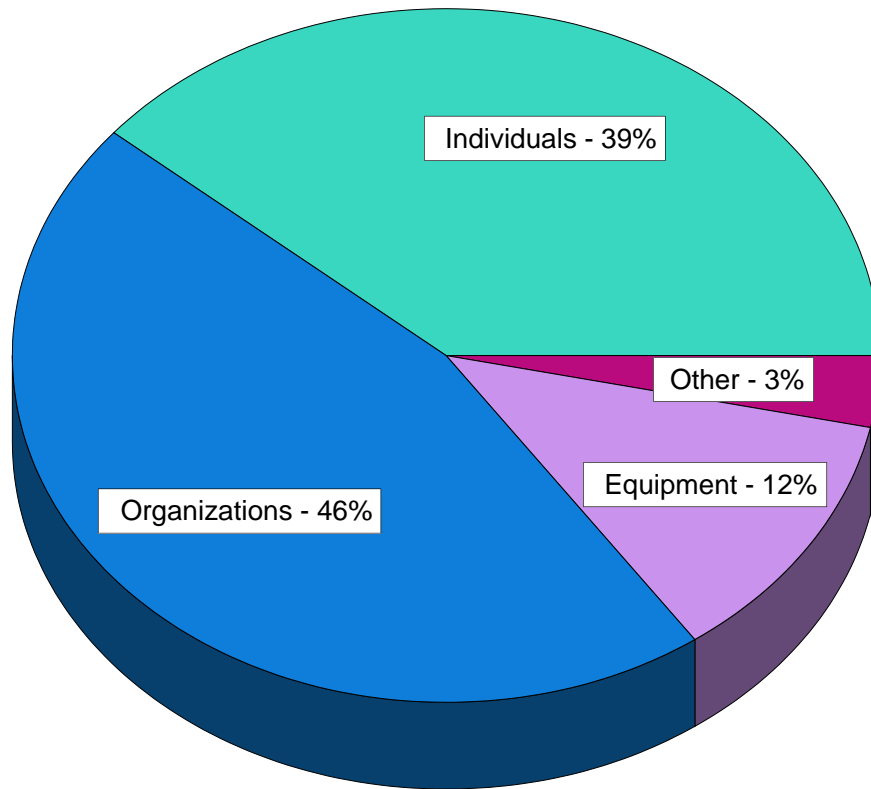


Chris

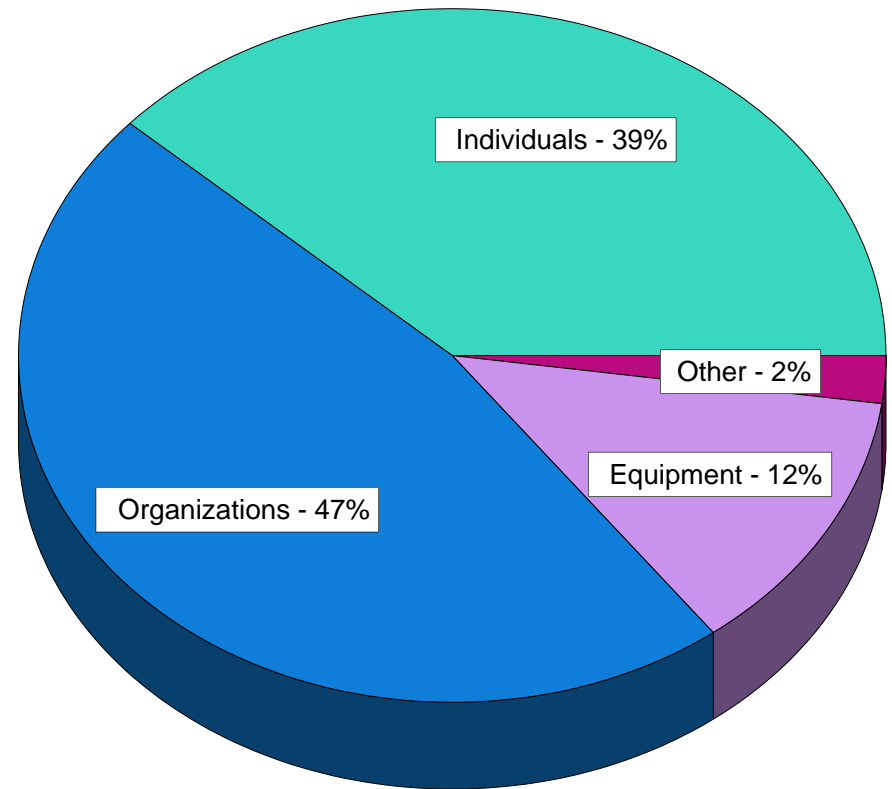


Michael

Another Look at NTSB Combined



Chris



Michael

What We Found — TSB

TSB Differences

- Reports include accidents and incidents
 - Generally less severe consequences
 - Higher percentage of general aviation aircraft
- No distinction between probable causes and contributing factors; sections are
 - Findings as to Causes and Contributing Factors
 - Findings as to Risk
 - Other Findings
- We considered only the 1st of these, but probably should've considered the 2nd, too.

Example — Findings As to Cause ...

The helicopter engine lost power in flight (engine flame-out) because of fuel starvation.

The usable fuel in the left cell was exhausted. Although there was fuel in the right cell, it was not available at a usable rate because the right boost pump was inoperative and the fuel transfer was slower than engine fuel usage.

When the right boost pump is inoperative, the fuel quantity gauge indicates more fuel than is actually on board. The actual amount of usable fuel would be difficult to determine in flight.

Example — Findings As to Cause ...

The helicopter engine lost power in flight (engine flame-out) because of fuel starvation. **Not a cause**

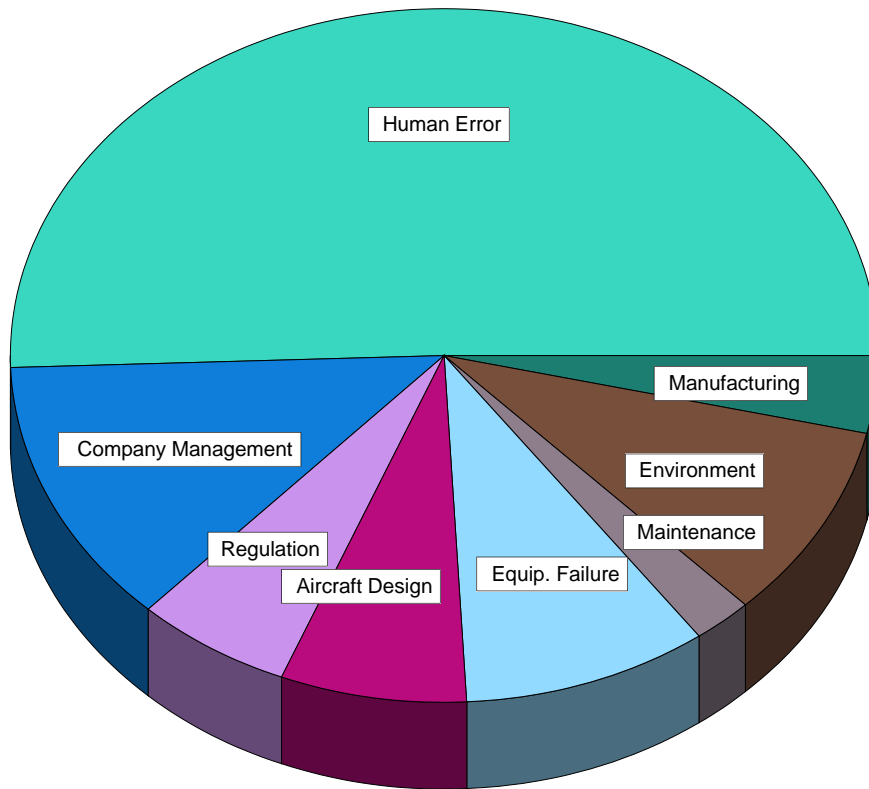
The usable fuel in the left cell was exhausted. Although there was fuel in the right cell, it was not available at a usable rate because the right boost pump was inoperative and the fuel transfer was slower than engine fuel usage. **Equip. Failure**

When the right boost pump is inoperative, the fuel quantity gauge indicates more fuel than is actually on board. The actual amount of usable fuel would be difficult to determine in flight. **Equip. Failure or Aircraft Design**

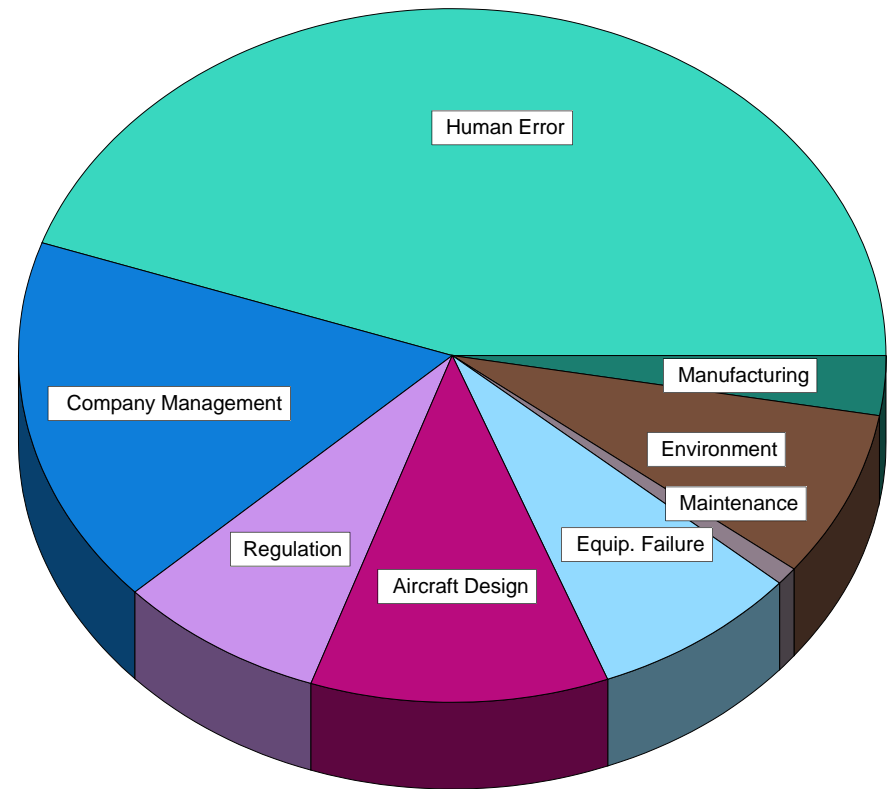
Combined Cause Distribution (TSB)

	Chris	Michael
Human	51%	44%
Maintenance	2%	1%
Company	12%	17%
Regulation	6%	8%
Equipment	9%	8%
Aircraft	7%	11%
Manufacturing	4%	3%
Environment	9%	8%

TSB Combined (both)

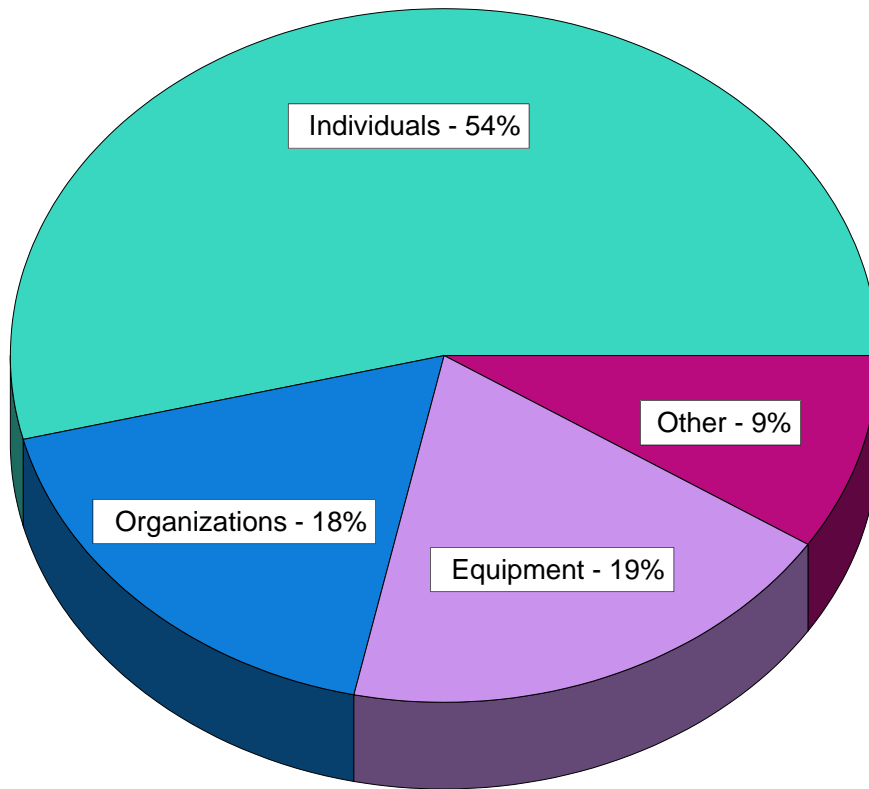


Chris

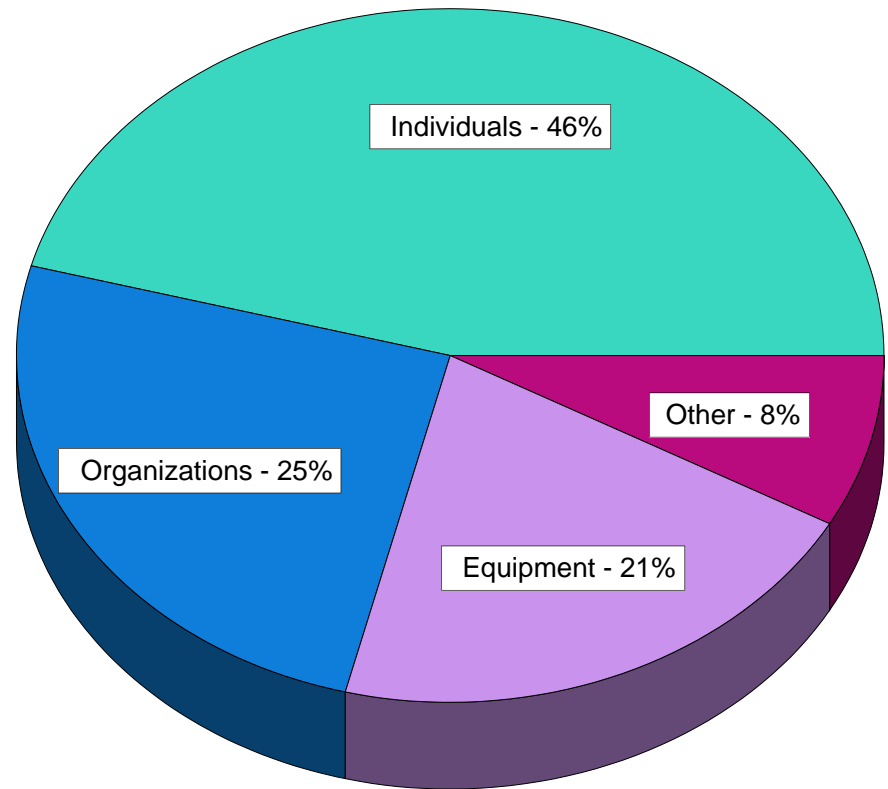


Michael

Another Look at TSB Combined



Chris



Michael

Meaning

Answers to the Two Questions

(for NTSB & TSB major aviation accident investigations)

- Do investigators usually blame operators?
 - ▶ Not unless 'usually' means simply 'more often than any other single causal factor'
 - ▶ That's not what the critics usually mean; they usually mean 'in a (super) majority of all accidents'
- Do investigators stop as soon as they find someone to blame?
 - ▶ Definitely not; other factors are almost always identified
 - ▶ Organizational factors are explored quite a bit (particularly in our sample by the NTSB)

Questions To Explore

- Is the difference between the NTSB & TSB significant?
- Do the results generalize to ...
 - ... all aviation accidents & incidents?
 - ... other transportation modes?
 - ... non-transportation accidents?
 - ... other investigation agencies?
- Would looking at older accident reports show different results?

Speculative Answers

- Is the difference between the NTSB & TSB significant? No, probably function of types of accidents investigated, and our choice to not include 'Findings as to Risk', not the agencies

Speculative Answers

- Is the difference between the NTSB & TSB significant? No, ...
- Do the results generalize to ...
 - ... all aviation accidents & incidents? Yes, but ...
 - ... other transportation modes? Yes, but ...
 - ... non-transportation accidents? Not sure
 - ... other investigation agencies? Mature ones
- Would looking at older accident reports show different results?

Speculative Answers

- Is the difference between the NTSB & TSB significant? **No, ...**
- Do the results generalize to ...
 - ... all aviation accidents & incidents? **Yes, but ...**
 - ... other transportation modes? **Yes, but ...**
 - ... non-transportation accidents? **Not sure**
 - ... other investigation agencies? **Mature ones**
- Would looking at older accident reports show different results? **Almost certainly**

Concluding Remarks

- Just because lots of people say something is true, doesn't mean that it is true
- People who think that getting rid of pilots will dramatically reduce the accident rate are even more deceived than I thought they were
- Everyone should apply for the Thompson Fellowship; if selected, you can do interesting work without interference

Postscript

- A conference paper describing the NTSB results is available at
<http://snipurl.com/74dt>
- A conference paper describing the TSB results will be available by mid-June
- A journal article describing the combined results in great detail will eventually be available